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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

PCT

(PCT Article 36 and Rule 70)



Applicant's or agent's file reference P045211PCT HHU/jdo	FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/PEA/416)	
International application No. PCT/NL 03/00647	International filing date (day/month/year) 18.09.2003	Priority date (day/month/year) 18.09.2002
International Patent Classification (IPC) or both national classification and IPC H04R25/00		
Applicant STICHTING VOOR DE TECHNISCHE WETENSCHAPPEN et al.		

- This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
- This REPORT consists of a total of 16 sheets, including this cover sheet.

☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

 These annexes consist of a total of 9 sheets.

- This report contains indications relating to the following items:
 - ☒ Basis of the opinion
 - ☐ Priority
 - ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
 - ☒ Lack of unity of invention
 - ☒ Reasoned statement under Rule 66.2(a)(ii) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
 - ☐ Certain documents cited
 - ☐ Certain defects in the international application
 - ☐ Certain observations on the international application

Date of submission of the demand 15.04.2004	Date of completion of this report 21.01.2005
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**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/NL 03/00647

I. Basis of the report

1. With regard to the **elements** of the international application (*Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17)*):

Description, Pages

1-31 as originally filed

Claims, Numbers

1-38 received on 17.12.2004 with letter of 16.12.2004

Drawings, Sheets

1/10-10/10 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
☐ the language of publication of the international application (under Rule 48.3(b)).
☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
☐ filed together with the international application in computer readable form.
☐ furnished subsequently to this Authority in written form.
☐ furnished subsequently to this Authority in computer readable form.
☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
☒ the claims, Nos.: 39-44
☐ the drawings, sheets:

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5. ☐ The report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)).

Replacement sheet containing such amendments must be referred to under item 1 and annexed to this

observations, if necessary:

Unity of invention

As to the invitation to restrict or pay additional fees, the applicant has:

☐ restricted the claims.

☐ paid additional fees.

☐ paid additional fees under protest.

☐ neither restricted nor paid additional fees.

☐ This Authority found that the requirement of unity of invention is not complied with and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

6. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

☐ complied with.

☒ not complied with for the following reasons:

see separate sheet

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

☒ all parts.

☐ the parts relating to claims Nos. .

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-38
	No: Claims	
Inventive step (IS)	Yes: Claims	12-31
	No: Claims	1-11, 32-38
Industrial applicability (IA)	Yes: Claims	1-38
	No: Claims	

2. Citations and explanations

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see separate sheet

Re Item IV

Lack of unity of invention

The examination authority is of the opinion that there are 2 inventions covered by the set of claims filed with the letter dated 16.12.2004:

i) invention 1: claims 1-31

a hearing aid consisting of different functional modules.

ii) invention 2: claims 32-38

a hearing aid which is able to recognise the speech signal of a user and to suppress this speech signal.

The reasons for which the inventions are not so linked as to form a single general inventive concept, as required by Rule 13.1 PCT, are as follows:

The document D1=WO9921400 discloses a hearing aid (in combination with spectacles) for improving the hearing ability of the hard of hearing.

Concerning invention 1 it is noted that, starting from D1, the special technical features of the first invention consist of a hearing aid (in combination with spectacles) comprising a number of functional modules which can be distributed over different components. The technical problem (1) solved by these features is to make the hearing aid (in combination with spectacles) more comfortable to wear.

Concerning invention 2 it is noted that, starting from the closest prior art D1, the special technical features of the second invention consist of a hearing aid in which the user's speech signal can be isolated by means of focusing and signal processing from the overall sound detected by a microphone (array) of the hearing aid. The technical problem (2) solved by these features is to avoid too high a reproduction of the user's own voice.

The special technical features of invention 1 are not the same as those of invention 2. A comparison of the technical problem (1) with the technical problem (2) indicates that there is no common or corresponding technical effect, such that the special technical features of invention 2 fail to demonstrate a correspondance with the special technical features of invention 1 as required by Rule 13.1 and 13.2 PCT.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT - SEPARATE SHEET**

International application No. PCT/NL 03/00647

Re Item V

Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1 Reference is made to the following documents:

- D1: WO 99/21400 A (UNIV DELFT TECH ;BERKHOUT AUGUSTINUS JOHANNES (NL); BOONE MARINUS) 29 April 1999 (1999-04-29)
- D2: EP-A-1 017 252 (RESISTANCE TECHNOLOGY INC) 5 July 2000 (2000-07-05)
- D6: US-A-6 104 822 (LINDEMANN ERIC ET AL) 15 August 2000 (2000-08-15)
- D7: WO 2004/016037 A (SONG YING ;CHEN JIAN FENG (SG); SUN HAN WU (SG); YU ZHU LIANG (SG)) 19 February 2004 (2004-02-19)
- D8: US-A-5 511 128 (LINDEMANN ERIC) 23 April 1996 (1996-04-23)

- D10: DE3032311
- D11: CH691944

The documents D10 and D11 were not cited in the international search report. Copies of the documents are appended hereto.

2 Addition of subject-matter, Art. 19(2) and 34(2)(b) PCT

New claim 1 is based on original claim 27 combined with original claim 36. However, several changes have been made, the following of which are not allowable under Art. 19(2) and 34(2)(b) PCT:

- i) the term "hearing-aid/spectacles combination" has been changed into "hearing aid". This change is however not allowed since throughout the application the invention of using a modular approach in a hearing aid has been presented by means of a hearing-aid/spectacles combination. In fact, throughout the application, the microphone array used to detect the sound in the hearing-aid/spectacles combination is presented as being implemented in the spectacles' arm. Omitting the reference to the spectacles in the claim 1 would require a non-obvious change in the features of the hearing aid to accommodate the microphone array.
- ii) it was mentioned in original claim 27 that the components are connected to one another. This feature has been omitted although it is essential for the invention since the components transmit signals to each other.

- iii) in new claim 1 the phrase "to instruct these components to which at least one of the function modules has been assigned to perform a selected signal processing operation of said plurality of different signal processing operations" is unclear. Therefore it can lead to an interpretation which goes beyond the original disclosure.

For the purposes of this report (in particular point 4.1 below), it is assumed that the above objections are overcome by the following:

- i) the hearing aid of claim 1 is a hearing-aid/spectacles combination.
- ii) the components are supposed to be electrically connected to each other.
- iii) the above wording is taken to mean that "each of the components uses its capacity to perform the signal processing of the at least one function module assigned to that component" (cf. claim 36 as originally filed).

3 Clarity, Art. 6 PCT

Apparatus **claims 1, 12 and 32** have been drafted as independent claims. It is however considered appropriate to use only one single independent apparatus claim. The aforementioned claims therefore lack conciseness and as such do not meet the requirements of Article 6 PCT.

As already pointed out in point 2 above, the phrase in **claim 1** "to instruct these components to which at least one of the function modules has been assigned to perform a selected signal processing operation of said plurality of different signal processing operations" is unclear. For the purposes of this report, the above wording is taken to mean that "each of the components uses its capacity to perform the signal processing of the at least one function module assigned to that component" (cf. claim 36 as originally filed).

Claim 3 comprises the term "hearing aid spectacles", for which there is no antecedent. For the purposes of this report, it is assumed that a hearing aid as in claim 1 is meant [i.e. with the assumption given in point 2 i) above: a hearing-aid/spectacles combination].

Claims 5-7 mention "*the* control unit" for which there is no antecedent. Furthermore, the term "can be configured" in these claims is unclear as it implies that the hearing aid has different settings which can be selected by the user e.g.

via a switch. For the purposes of this report it is therefore assumed that the term "can be configured" is replaced by "is configured".

Claim 6 referring back to claim 5 specifies that the hearing aid, which is configured in claim 5 as an audio player, is also configured for use as a headset in a communication link. However, there is no support in the description for this combined use of the hearing-aid system as an audio player and a headset.

The wording of **claim 8** is unclear. Taking claim 8 in combination with claim 9 and based on the description p. 24, l. 7 - p. 25, l. 22, it is interpreted that the hearing aid uses a focusing technique to essentially remove the user's own voice from the received sound signal. However, it is pointed out that even with this interpretation it remains unclear how the focusing technique identifies a signal as corresponding to the user's own speech.

Claim 12 relates to a hearing-aid/spectacles combination comprising a beam-forming module together with a reproduction-adaptation module and specifies that this beam-forming module and reproduction-adaptation module can be integrated in a mobile phone, personal audio equipment or a personal information management system. However, the term hearing-aid/spectacles combination does not comprise a mobile phone, personal audio equipment or a personal information management system and therefore it is unclear what is the scope of protection intended by the claim. For the purposes of this report, it is assumed that the term "hearing-aid/spectacles combination" is replaced by a term which takes into account, as appropriate, either one of a mobile phone, personal audio equipment or a personal information management system.

Furthermore, claim 12 also states that the beamforming module and reproduction-adaptation module can be connected to a mobile phone instead of integrated. In the light of the description p. 18, l. 8-19, it is assumed that this connection is electric or electromagnetic.

For **claim 13** a similar clarity objection as for claim 12 is raised with respect to the separate processing unit (4).

Claim 14 has no antecedent for the term "the processing unit" when referring back to claim 12.

Claim 32 specifies that the microphone array in the hearing-aid system registers a

sound signal which contains a sound signal related to the speech of a user of the hearing aid and that the hearing-aid system is equipped to minimise amplification of the sound signal related to the speech of the user such that the user hears his or her speech at a normal level. However, claim 32 fails to specify how the hearing-aid system recognises the user's own voice and how the minimisation is performed. Therefore claim 32 merely states the result which is to be achieved. Furthermore, it is unclear for the skilled person what is meant by the term "normal" in the phrase "a normal level compared with amplified sound signals relating to the surroundings".

In claim 35 it is unclear what is meant by "the speech signal".

Claim 38 refers back to claim 37 and mentions "the incoming communication signal", for which there is no antecedent if claim 37 is taken to refer back to claims 32-34. Furthermore, the reference sign "Cin" is used to designate "one input of the communication link" as well as "the incoming communication signal".

4 Novelty and inventive-step reasoning, Art. 33(2) and 33(3) PCT.

4.1 Negative statements for the independent claims

a. Concerning claim 1:

Under the assumptions made in point 2 above, the present application does not meet the criteria of Article 33(1) PCT, because the subject-matter of claim 1 does not involve an inventive step in the sense of Article 33(3) PCT.

The document D2, which is considered the closest prior art, discloses (the references in parentheses applying to this document):

a hearing aid provided with components (para. [0006]), function modules (para. [0004], [0012] and [0015]) and a reproduction-control module (para. [0010]-[0012]: digital signal processor issues control signal for reproducing sound) connected to said function modules,
the components comprising a microphone array (para. [0010] and Fig. 3: microphones 26, 28, 30; Fig. 4, microphone array) and at least one reproduction unit (para. [0010]: reproduction units in the earpieces 12 and 14), the microphone array being equipped to pick up a sound signal and to transmit a processed signal produced on the basis thereof to the at least one reproduction unit (para. [0010]) and the components being equipped with a capacity for performing a plurality of different signal processing operations (para. [0006], [0010]-[0015]),

and

the function modules encompassing a sound registration module (implicitly disclosed by the microphones 26, 28, 30 of para. [0010]), a beam-forming module (implicitly disclosed by the digital signal processor which performs beam forming, see para. [0016]), a reproduction-adaptation module (para. [0023]-[0027]: noise attenuation functionality) for adapting a sound-reproduction characteristic for sound to be reproduced and a reproduction module (implicitly disclosed by the reproduction units in the earpieces 12 and 14 of para. [0010]) for reproducing the sound to be reproduced on the basis of a reproduction characteristic and as controlled by the reproduction-control module.

The subject-matter of claim 1 differs from D2 in that

a) the claimed hearing aid is used in a hearing-aid/spectacles combination [see assumption of point 2 i) above]

and that

b) the claimed reproduction control module

- stores different function scenarios for different use situations,
- is arranged to receive an input selection signal for one of said use situations and to assign at least one of the function modules to one or more of the components based on the input selection signal and
- instructs the components, to which at least one of the function modules has been assigned, to perform a selected processing operation of said plurality of signal processing operations.

Concerning a) it would be obvious for the skilled person to implement the modular idea of D2 in any kind of hearing aid available in the prior art, e.g. the hearing-aid/spectacles combination of D1 (p. 1, l. 13 - p. 2, l. 21).

Concerning b) it is noted that the following problem can be defined: how to allow for more flexibility in the use of a hearing aid. D6 (col. 6, l. 39 - col. 7, l. 8; col. 8, l. 30 - col. 9, l. 51) addresses the same problem and provides a plurality of digital signal processing means, which are each tailored for a particular listening situation and which can be selected by the user via a selector switch. More in particular:

- this plurality of tailored digital signal processors are implemented as different programs (i.e. function scenarios) stored in a multi-program store (D6: col. 9, l. 18-51),
- based on the selector switch a particular program (i.e. function scenario) is assigned for execution by the digital signal processor (D6:

col. 9, l. 18-51: ALU), which is connected to an input and output transducer (D6: Fig. 1a, microphone 42, digital signal processors 50, speaker 54).

- it is self-evident that once the particular program has been loaded for execution by the digital signal processor, this digital signal processor will use its capacity to perform the appropriate processing operation(s) as instructed by the program.

It is noted that features (a) and (b) mentioned above do not produce any non-obvious working inter-relationship.

In conclusion, the subject-matter of claim 1 does not imply an inventive step.

b. Concerning **claim 32** (unclear, see point 3 above)

Claim 32 relates to a hearing aid comprising a first reproduction unit and a microphone array, wherein the microphone array registers a sound signal which contains a sound signal related to the speech of a user of the hearing aid and wherein the hearing aid is equipped to minimise amplification of the sound signal related to the speech of the user such that the user hears his or her speech at a normal level.

Document D8 shows a hearing aid which is equipped to register sound containing the speech of a user (col. 3, l. 41-65: it is clear that the sound received by the hearing aid will also contain the user's speech) and discloses (col. 3, l. 45-50) the selection of a speech signal of a speaker by means of beam forming whereby the other signals are attenuated (such that the user can focus on the speaker). This beam forming also results in a reduction in the level of the user's own voice.

4.2 Negative statement for the dependent claims

Claim 2 further specifies that each of the components of claim 1 communicate with one another wirelessly. This is also disclosed in D2 (para. [0010]-[0011], wireless FM communication).

Claim 3 further specifies that the hearing aid of claim 1 can be configured as a hearing aid for directional hearing, as an audio player or as a GSM handset. The option in claim 3 in which the hearing aid is configured for directional hearing is

anticipated by the beam-forming module in the hearing aid of D2 (para. [0016]). Furthermore, it is well-known in the art that an FM receiver can be incorporated in a hearing aid, see e.g. D10 (p. 1, para. 1-5; Figs. 2 and 4, FM receiver 2) or D11 (col. 1, l. 3-6; col. 2, l. 10-64). This allows to combine a hearing aid with the use of modern telecommunication and entertainment (music, television, etc.) devices. The options to configure the hearing-aid system as an audio player or as a GSM headset are therefore also anticipated by the prior art.

Claim 4 further specifies a hearing aid of claim 1 with sound registration in the microphone array, beam forming in the frame and wireless transmission from the frame to the reproduction unit. These features are also disclosed in the combination of documents D1 with D2 for the following reasons. From D2 (para. [0012] and [0015]) it follows that the digital signal processor performing the beam forming can be integrated in the earpiece of the conventional hearing aid. Applying D2 to the hearing aid of D1 (Fig. 4, sound registration by means of microphone arrays 26-29 and 33-36), it would be a workshop modification to put the digital signal processor in the frame instead of in the earpiece. Finally, D1 does not explicitly disclose a wireless connection between frame and reproduction unit. However, given the teaching of wireless communication between components in D2 (para. [0010]-[0012], [0015]), a wireless connection between the frame and reproduction unit is one of the possibilities which the skilled person would consider and implement according to the dictates of circumstance.

Claims 5-6 relate to the configuration of the hearing-aid system as an audio player or a headset with a particular distribution of the function modules over the components and with a wireless transmission connection between certain components. As already indicated in the comments with respect to claim 3 it is well-known in the art that an FM receiver can be incorporated in a hearing aid, which anticipates the configuration of the hearing aid system as an audio player or as a headset. Furthermore, it is known from D2 (para. [0015]) that in a modular hearing-aid system the functional components (or function modules for that matter) can be rearranged over the system as is deemed appropriate. Finally, wireless communication between components in a hearing-aid system is also known from D2 (para. [0010]-[0012], [0015]).

Claim 7 relates to a hearing-aid system as in claim 6 wherein a speech signal is selected by means of beam forming. From D2 (para. [0027]) it is well-known that beam forming allows the user of a hearing-aid system to focus attention on a

desired sound source [e.g. a speech signal]. Claim 7 also specifies that the user's speech is registered, which is obvious as a hearing aid normally registers all sounds from the surroundings, including the user's own voice.

Claim 8 (unclear, see point 2 above) and **claim 9** further specify the hearing-aid system uses a focusing technique to essentially remove the user's own voice from the received sound signal, thus obtaining a reduced sound signal. As pointed out in the comments with respect to independent claim 32, this is known from D8. Claim 9 further specifies that an incoming communication signal, received from a headset, is added to the reduced sound signal. This additional feature is well-known in the art (e.g. when a T-coil is used in a hearing aid) and allows the wearer of a hearing-aid to receive sound from the ambient environment as well as sound from a headset.

Claim 10 further specifies that each of the components of claim 1 comprises at least one digital circuit for performing one or more of the function modules. D2 discloses that the digital signal processor may be located in the medallion or in the earpieces or in other physical parts of the system (para. [0015]). Furthermore, it is clear from Fig. 4 in D2 that the component comprising the microphone array also comprises a digital circuit, namely the A/D converter 52 (see also para. [0011]).

Claim 11 further specifies that the hearing aid of claim 1 is used in a hearing-aid/spectacles combination. Given the assumption with respect to claim 1 in point 2 i), this claim is redundant.

Claim 33 further specifies that the beam-forming and signal-processing [means] of claim 32 comprises a focusing technique to minimise the amplification of the user's own speech signal. This is also disclosed in D8 (col. 3, l. 45 - col. 4, l. 15: beamforming is a focusing technique).

Claim 34 further specifies that the hearing aid of claim 32 is arranged to perform null-steering to minimise the amplification of the user's own speech signal. The use of null-steering is well-known in the art, see e.g. D2 (para. [0016] and [0027]) and the skilled person would use it to implement the beam-forming technique of D8 when appropriate.

Claim 35 further specifies that the hearing aid of claim 32 serves as a headset in a communication link. As already pointed out in the comments with respect to

claim 6, this additional subject-matter does not render the claim inventive.

Claim 36 further specifies that the hearing aid of claim 35 essentially removes a speech signal from the received sound signal to create a reduced sound signal and adds a communication signal received via the headset to the reduced sound signal. As set out in the comments with respect to claim 9, this additional subject-matter does not render the claim inventive.

Claim 37 further specifies that the hearing aid of claim 32 is provided with a first beam former to register a first sound signal from a source relatively far away and a second beam former for registering a second sound signal from the user's speech and whereby, using complex multiplication and summing of the received signals, the user's speech is suppressed from the received signal. As already indicated in the comments with respect to claim 32, the use of beam forming to focus on a speaker (e.g. relatively far away) and to suppress the user's voice is well-known in the art. Also, it is well-known that this beam forming can be implemented by means of complex linear combination of received signals.

Claim 38 further specifies that in the hearing aid of claim 37 a communication signal coming from a headset is added to the reduced sound signal. As already indicated in the comments with respect to claim 9 this additional feature is well-known in the art.

4.2 Positive statement for the independent claims

Claim 12 (unclear, see point 3 above) relates to a hearing-aid/spectacles combination having at least five basic modules comprising a sound-registration module, a beam-forming module, a reproduction-adaptation module, a reproduction module and a reproduction-control module, whereby the beam-forming module and the reproduction-adaptation module are either

- integrated with or connected to a mobile phone, the hearing-aid/spectacles combination being equipped as a handsfree set, or
- integrated with either personal audio equipment or a personal information management system.

In the following it is assumed that the clarity objections raised in point 3 with respect to claim 12 have been overcome.

As indicated in point 3.1 above, D2 shows a hearing aid having modules and can be combined with document D1, which shows a non-modular hearing-aid/spectacles combination. The modules mentioned in D2 are the same as those mentioned in claim 12. However, it is not shown in the prior art cited in the international search report that the beam-forming module and the reproduction-adaptation module is to be integrated in a mobile phone or in personal audio equipment or in a personal information management system or is in electric or electromagnetic connection with these systems. Furthermore, there is no motivation for the skilled person to integrate or to connect the beam-forming module and the reproduction module in the way of claim 12.

The technical effect is the following: when the processing unit performing the beam-forming and reproduction-adaptation module is integrated in a mobile-phone system (or in personal audio equipment or in a personal information management system), this processing unit can be given supplementary functionality (e.g. functionality which is typical for a mobile phone, personal audio equipment or a personal information management system), which leads to a reduction in the number of components in the global hearing-aid/spectacles/mobile-phone system, resp. the global hearing-aid/spectacles/personal-audio-equipment system or the global hearing-aid/spectacles/personal-information-management system.

As a result, claim 12 fulfils the requirements of Art. 33(2) and 33(3) PCT.

4.3 Positive statement for the dependent claims:

Claims 13-31 depend on claim 12 and are allowable under Art. 33(2) and 33(3) PCT for the same reasons as set out in point 4.2 above.

5 Industrial applicability, Art. 33(4) PCT.

The **claims 1-38** fulfil the requirements of Art. 33(4) PCT for obvious reasons.

6 Further remarks.

In **claim 5**, a word seems to be missing between "Claims 1-4" and "the hearing aid".

In **claim 33**, the word "means" seems to be missing between "processing" and

INTERNATIONAL PRELIMINARY

International application No. PCT/NL 03/00647

EXAMINATION REPORT - SEPARATE SHEET

"(B2 and B3)".